



AUCKLAND TRANSPORT

Clonbern Road Carpark

Monthly Monitoring Inspection Report September 2018

September 2018

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1. Introduction

1.1 Purpose of this Report

Auckland Transport have commissioned GHD to carry out a “Monthly Monitoring Inspection” of the Clonbern Road Carpark, Remuera (Auckland) due to concerns over the long term durability of the asset and water ingress into structural components. Further inspections are required on a monthly basis following the first inspection by GHD on 20th December 2017. The elements monitored by GHD through site survey were a continuation of defects noted in a previous OPUS Monthly Monitoring report (refer section 1.2).

GHD conducted this ninth round of field monitoring survey on 11th September 2018 at the Clonbern Road Carpark at the same locations previously determined by OPUS. Since GHD’s initial inspection in December 2017, this has included:

- Initial installation of monitoring pins either side of the OPUS previously monitored crack locations on the level 2 deck
- Visual inspection and site monitoring survey of 17 locations on beam and hollow core units on Level 1 to measure deflection and 12 crack locations on the Level 2 deck to measure crack width
- Inclusion of an additional survey location on the hollow core units (3B) initiated under April’s monitoring
- Inclusion of 3 additional survey locations on the end beam and hollow core units (D4, D5, D6) initiated under the August 2018 monitoring
- Report on the findings of the monitoring results including layout plans of locations and photos.

Figure 1: View of the upper level carpark and weight restriction



1.2 Previous Reports

GHD undertook a “Structural and Facilities Assessment” of the Clonbern Carpark Facility in December 2017. Opus conducted their most recent monthly monitoring inspection of the

carpark cracks and deflection similar to this monitoring report in September 2018. This was the last within their contract.

1.3 Description of the Structure

Clonbern Road Car Park consists of the following structural elements:

- Level 1 asphalt parking area
- Level 2 concrete parking area
- Concrete and steel strengthened structure
 - Columns
 - Beams
 - 200 mm Deep hollow core units
 - 65 mm Concrete topping – Level 2
 - Hollow core units seating angles
 - U Shaped galvanised plates
 - Concrete vehicle ramp
 - Concrete pedestrian bridge
 - Timber retaining walls and block wall.

1.4 Assumptions and Limitations

During the initial site inspection in December 2017, GHD have noted the following limitation, as follows:

- From an initial site inspection, it was difficult in locating the exact survey mark position of the points on the Level 1 roof soffit (hollow core units), and crack width locations from previous Opus monitoring (through faded markings on level 2 of the carpark). GHD cannot guarantee the exact measured location when using an inverted staff and crack width ruler for this initial survey inspection when comparing to the previous Opus results. GHD have therefore installed monitoring pins on the level 2 deck to ensure accurate monthly crack width measurements and clearly marked deflection points.

Figure 2: GHD deflection marking at IB2, IB3 and monitoring pins installed



1.5 Explanatory Statement

This report: has been prepared by GHD for Auckland Transport and may only be used and relied on by Auckland Transport for the purpose agreed between GHD and Auckland Transport.

GHD otherwise disclaims responsibility to any person other than Auckland Transport arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Inspections undertaken in respect of this report are constrained by the particular site conditions, such as the location of asset elements, and environment. As a result, not all relevant site features and conditions may have been identified in this report. The inspections are based on the information available at the time of the inspection. No layout plans have been submitted by AT to GHD, outlining the inspection area to define AT asset boundary for inspection.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

The inspections undertaken were visual only unless otherwise specified in this report. As a result, not all relevant site features and conditions may have been identified in this report.

GHD excludes and disclaims all liability for all claims, expenses, losses, damages and costs, including indirect, incidental or consequential loss, legal costs, special or exemplary damages and loss of profits, savings or economic benefit, Auckland Transport may incur as a direct or indirect result of the information entered into the SPM database, for any reason being inaccurate, incomplete or incapable of being processed on Auckland Transport's equipment or systems or failing to achieve any particular purpose. To the extent permitted by law, GHD excludes any warranty, condition, undertaking or term, whether express or implied, statutory or otherwise, as to the condition, quality, performance, merchantability or fitness for purpose of the SPM database.

2. Monitoring Findings

The survey monitoring data in Appendix B shows the relative movement within an 9-month period between the final Opus survey inspection and the 1st inspection carried out by GHD in late December 2017. It also displays GHD's monitoring for the period January 2018 to September 2018.

Following a site visual check of the Level 1 hollow core units in early April, GHD included an additional monitoring location (D3) to check for further movement where the hollow core units at the joint line show differing levels and where vegetation growth at the butted joint is active. GHD have included a further three additional monitoring locations (D4, D5 D6) in the August survey along Gridline B (see Appendix A Layout Plan).

Deflection Monitoring

Of the 17 monitored deflection locations (Appendix A) on the underside of the level 2 deck slab in this round of monitoring there were:

- As shown in figure 3, the maximum recorded deflection over a 9 month period was 4 mm at the end of cantilever beam (E3 - E4) at south western edge. This deflection has not changed since July 2018. The maximum incremental deflections from the start of monitoring (Opus October 2014) are at points D1 with 7 mm deflection and D2 with 5 mm of uplift readings when including the latest GHD September survey
- Monitoring point D1 and D2 have shown 2 mm and 1 mm deflection respectively; over 9 months since GHD have conducted monitoring. Previous Opus survey data alone (prior to GHD contract start) indicates for D1, D2 deflection of 6 mm and 5 mm respectively
- Location D3 (see Appendix A) has shown a 3 mm deflection since its initial monitoring at begin April 2018. There has been no change since the last reading on 7/8/2018
- Newly installed points (August period) at D4, D5, and D6 have shown 1mm change over the last month (D4).

Refer photo No's 13 – 16 (Appendix C) for Level 1 hollow core underside monitoring points.

Crack monitoring

The exact crack locations where Opus took previous measurement was difficult to determine, so GHD installed monitoring pins prior to the December 21 2017 readings to improve accuracy for further monthly measurement perpendicular to the crack line.

For the 12 locations on level 2 where crack width measurements were taken (see Appendix C), there were slight variances on the majority of the point locations from the initial GHD December 2017 readings with the following noted:

- Of the targeted 12 crack locations, all indicated progressive crack width opening except 3A, 5A & 6B
- The largest crack opening width since the GHD December start readings was at locations 3B, with 1.36 mm crack opening width increase as shown in figure 4.

Based on 9 month GHD monitoring results shown in figure 4, crack widths were increased by 0.2 – 1.36 mm in differing locations. This result shows 0.38 mm crack closing which may be due to temperature effects, with the monitoring being conducted on top of the concrete surface. GHD however will closely monitor these locations including the continued survey of the full 29 monitoring locations around the carpark structure.

A general visual inspection of the Level 2 deck crack locations and the Level 1 hollow core units and beam deflections indicate no further significant deterioration has occurred since the GHD baseline measurements in December 2017 and this ninth round of GHD monitoring inspection. There are 2 - 3 mm deflections recorded in three locations on the hollow core units during the 9 months of GHD monitoring.

At the time of the monitoring inspection, and with new weight limit signage recently installed at the entrance to the upper carpark level, it was observed there were approximately 15 vehicles (SUV's, Vans) believed to be over the 2 tonne weight limit. GHD believes the current fencing to remove vehicle parking from 10.0 m south of Glidline B will remain in place.

GHD recommends removal of the increased vegetation growth on the underside of the level 1 deck (see photo's 15 & 16) retaining the monitoring point, and clean, reseal of the joint above over a 10 metre length and concrete repair to the joint end intersection with Gridline B (see Appendix A, Layout plan).

Figure 3: Overall beam/slab deflection monitoring curve

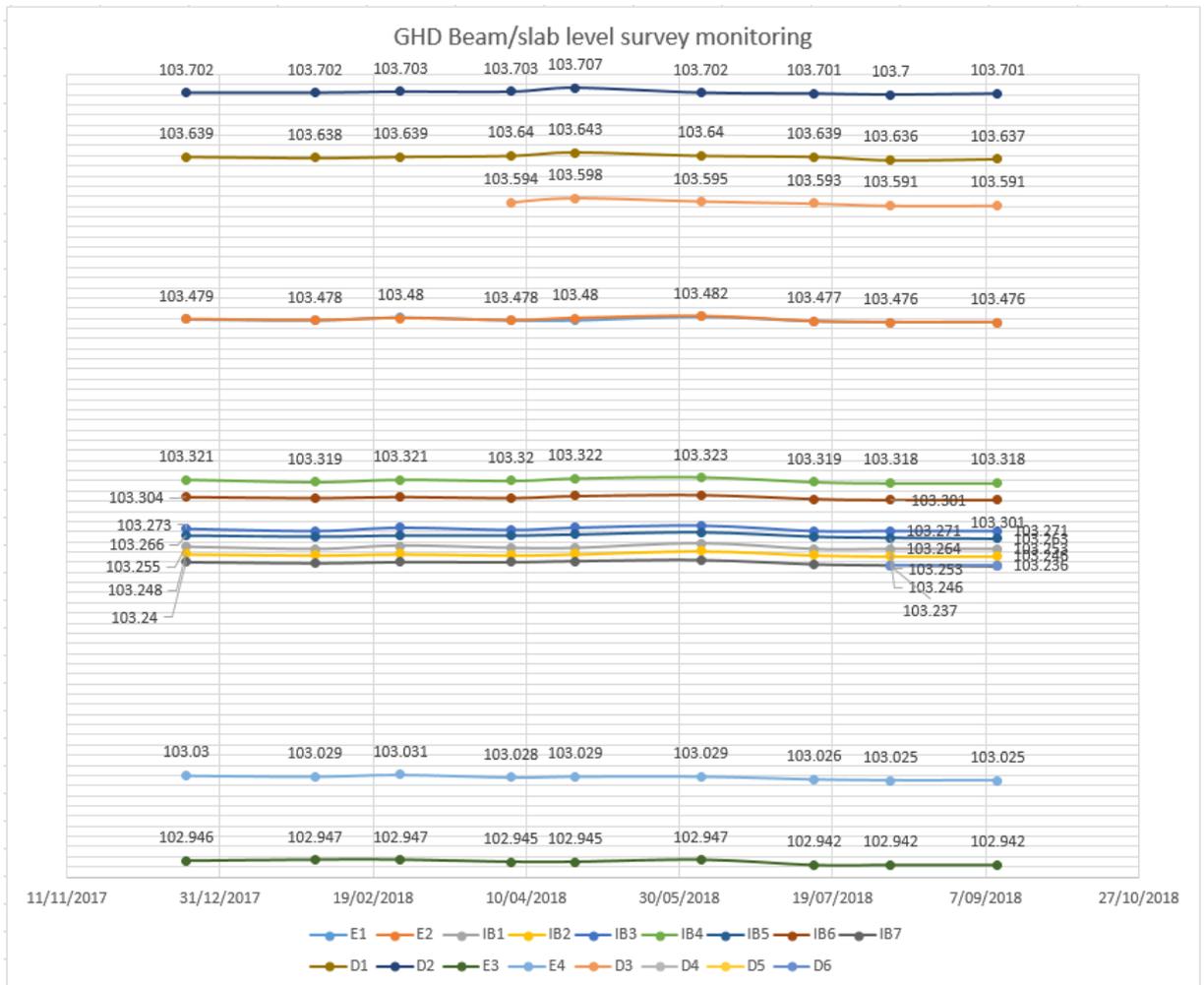
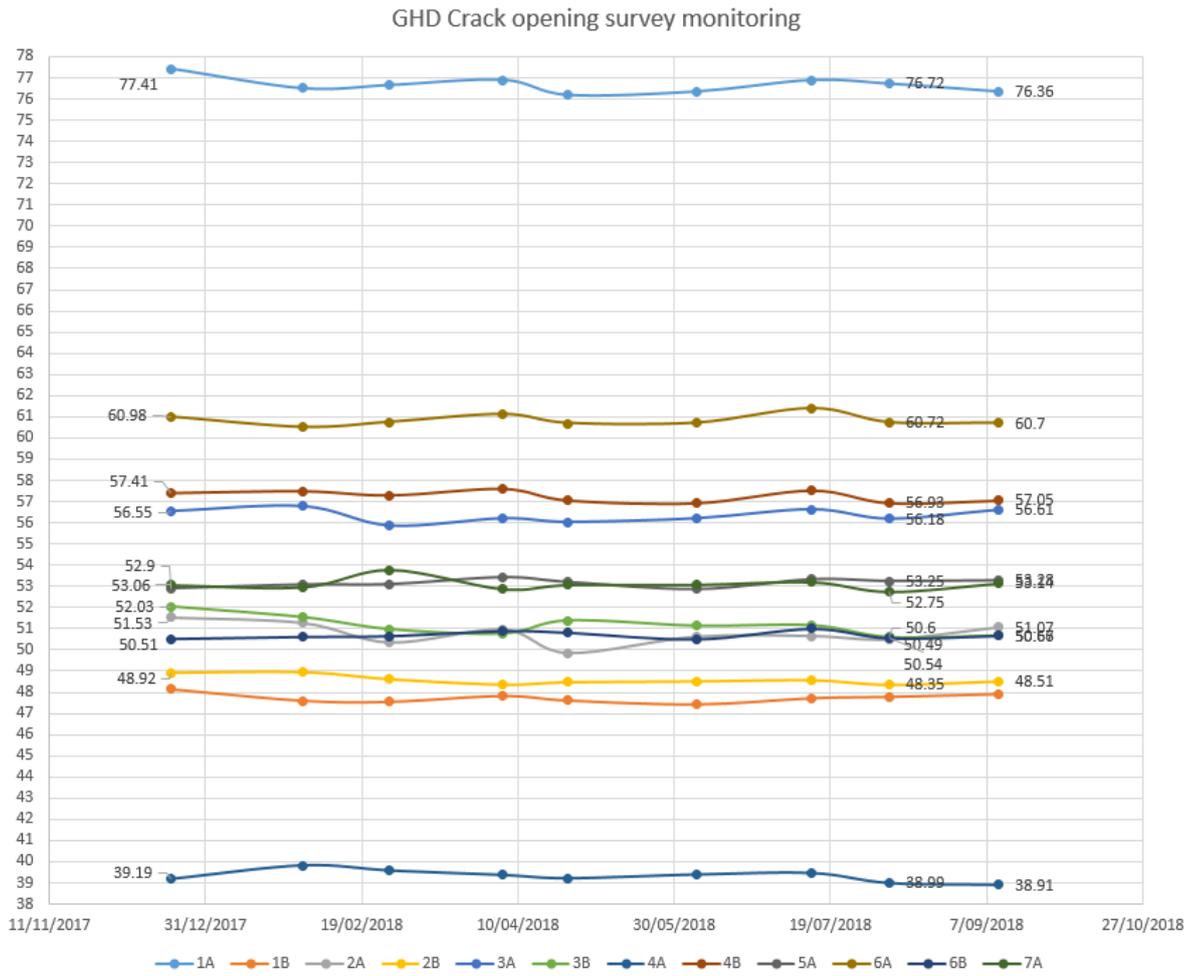
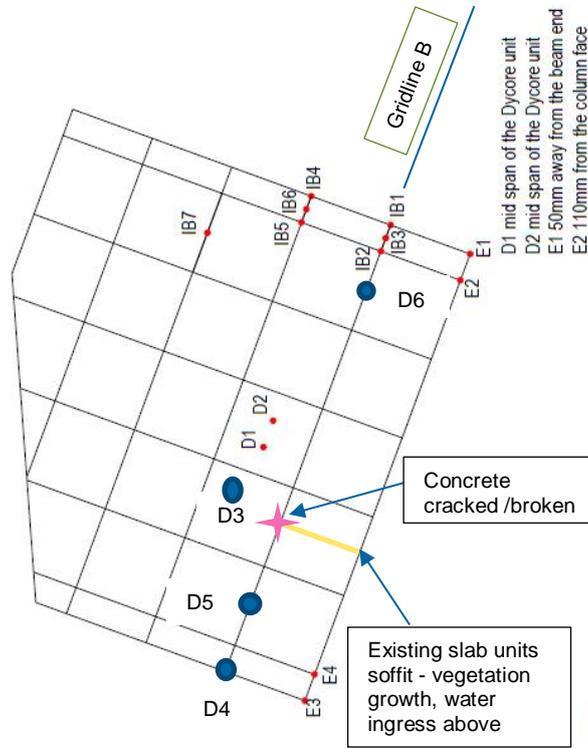


Figure 4: Overall crack width opening monitoring curve

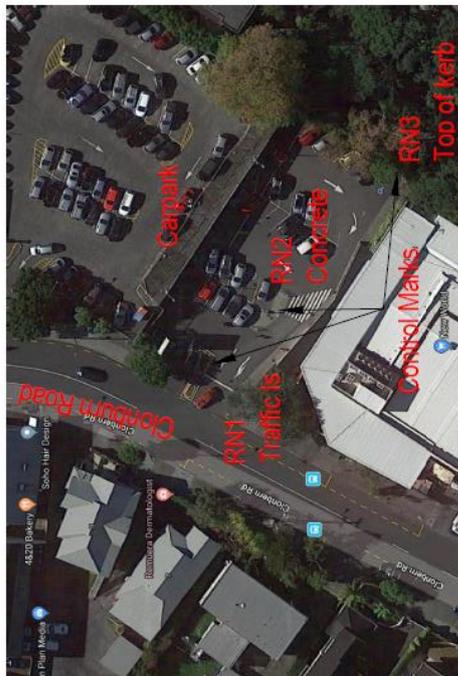


Appendices

Appendix A – Site Layout Plan & Deflection Monitoring points location



- Notes:**
1. Drawing shows approximate location of monitoring points
 2. Levels taken on underside of beams with inverted staff
 3. Points are marked on concrete with black marker
 4. RN 1 is a local assumed datum 100.00m RL
 5. Check marks RN2 100.21m RL & RN3 101.002m RL
 6. Instrument: Sokkisha, CN3 SN154552



Appendix B – Survey Monitoring Data

Clonbern Rd Carpark Monitoring - Level 1 Deflections

Job Number: 51 37681 56

Date of Survey: 1/10/2014 - Opus: Base Line

Note. Height Datum: Assumed
Origin: RM 1 100.00m RL
RN 2 100.210m RL
RN 3 101.002m RL

<u>Point</u>	<u>RL</u>
E1	103.472
E2	103.475
IB1	103.251
IB2	103.246
IB3	103.270
IB4	103.317
IB5	103.263
IB6	103.301
IB7	103.239
D1	103.643
D2	103.705
E3	102.940
E4	103.026

Date of Survey: 2/06/2017 - Opus

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference BM</u>
E1	103.477		0.005
E2	103.479		0.004
IB1	103.254		0.003
IB2	103.247		0.001
IB3	103.272		0.002
IB4	103.319		0.002
IB5	103.265		0.002
IB6	103.302		0.001
IB7	103.238		-0.001
D1	103.637		-0.006
D2	103.700		-0.005
E3	102.945		0.005
E4	103.027		0.001

Date of Survey: 20/12/2017 - GHD

(Opus 2/6/2017)

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference from Baseline</u>
E1	103.479	0.002	0.007
E2	103.479	0.000	0.004
IB1	103.255	0.001	0.004
IB2	103.248	0.001	0.002
IB3	103.273	0.001	0.003
IB4	103.321	0.002	0.004
IB5	103.266	0.001	0.003
IB6	103.304	0.002	0.003
IB7	103.240	0.002	0.001
D1	103.639	0.002	-0.004
D2	103.702	0.002	-0.003
E3	102.946	0.001	0.006
E4	103.030	0.003	0.004

Date of Survey: 31/01/2018

(GHD 20/1/2017)

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference from Baseline</u>
E1	103.478	-0.001	0.006
E2	103.478	-0.001	0.003
IB1	103.253	-0.002	0.002
IB2	103.247	-0.001	0.001
IB3	103.271	-0.002	0.001
IB4	103.319	-0.002	0.002
IB5	103.265	-0.001	0.002
IB6	103.303	-0.001	0.002
IB7	103.239	-0.001	0.000
D1	103.638	-0.001	-0.005
D2	103.702	0.000	-0.003
E3	102.947	0.001	0.007
E4	103.029	-0.001	0.003

Date of Survey: 28/02/2018

(GHD 31/1/2018)

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference from Baseline</u>
E1	103.481	0.003	0.009
E2	103.48	0.002	0.005
IB1	103.256	0.003	0.005
IB2	103.248	0.001	0.002
IB3	103.274	0.003	0.004
IB4	103.321	0.002	0.004
IB5	103.266	0.001	0.003
IB6	103.304	0.001	0.003
IB7	103.24	0.001	0.001
D1	103.639	0.001	-0.004
D2	103.703	0.001	-0.002
E3	102.947	0.000	0.007
E4	103.031	0.002	0.005

Date of Survey: 5/04/2018

(GHD 28/02/2018)

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference From BaseLine</u>
E1	103.478	-0.003	0.006
E2	103.478	-0.002	0.003
IB1	103.254	-0.002	0.003
IB2	103.247	-0.001	0.001
IB3	103.272	-0.002	0.002
IB4	103.32	-0.001	0.003
IB5	103.266	0.000	0.003
IB6	103.303	-0.001	0.002
IB7	103.24	0.000	0.001
D1	103.64	0.001	-0.003
D2	103.703	0.000	-0.002
E3	102.945	-0.002	0.005
E4	103.028	-0.003	0.002
D3	103.594		

Date of Survey: 26/04/2018

(GHD 05/04/2018)

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference From BaseLine</u>
E1	103.478	0.000	0.006
E2	103.48	0.002	0.005
IB1	103.254	0.000	0.003
IB2	103.248	0.001	0.002
IB3	103.274	0.002	0.004
IB4	103.322	0.002	0.005
IB5	103.267	0.001	0.004
IB6	103.305	0.002	0.004
IB7	103.241	0.001	0.002
D1	103.643	0.003	0.000
D2	103.707	0.004	0.002
E3	102.945	0.000	0.005
E4	103.029	0.001	0.003
D3	103.598	0.004	

Date of Survey: 6/06/2018

(GHD 26/04/2018)

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference From BaseLine</u>
E1	103.482	0.004	0.010
E2	103.482	0.002	0.007
IB1	103.258	0.004	0.007
IB2	103.251	0.003	0.005
IB3	103.276	0.002	0.006
IB4	103.323	0.001	0.006
IB5	103.269	0.002	0.006
IB6	103.306	0.001	0.005
IB7	103.242	0.001	0.003
D1	103.64	-0.003	-0.003
D2	103.702	-0.005	-0.003
E3	102.947	0.002	0.007
E4	103.029	0.000	0.003
D3	103.595	-0.003	

Date of Survey: 13/07/2018

(GHD 6/06/2018)

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference From BaseLine</u>
E1	103.477	-0.005	0.005
E2	103.477	-0.005	0.002
IB1	103.253	-0.005	0.002
IB2	103.247	-0.004	0.001
IB3	103.271	-0.005	0.001
IB4	103.319	-0.004	0.002
IB5	103.265	-0.004	0.002
IB6	103.302	-0.004	0.001
IB7	103.238	-0.004	-0.001
D1	103.639	-0.001	-0.004
D2	103.701	-0.001	-0.004
E3	102.942	-0.005	0.002
E4	103.026	-0.003	0.000
D3	103.593	-0.002	-0.001

Date of Survey: 7/08/2018

(GHD 13/07/2018)

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference From BaseLine</u>
E1	103.476	-0.001	0.004
E2	103.476	-0.001	0.001
IB1	103.253	0.000	0.002
IB2	103.246	-0.001	0.000
IB3	103.271	0.000	0.001
IB4	103.318	-0.001	0.001
IB5	103.264	-0.001	0.001
IB6	103.301	-0.001	0.000
IB7	103.237	-0.001	-0.002
D1	103.636	-0.003	-0.007
D2	103.7	-0.001	-0.005
E3	102.942	0.000	0.002
E4	103.025	-0.001	-0.001
D3	103.591	-0.002	-0.003
D4	102.754		
D5	102.868		
D6	103.237		

Date of Survey: 11/09/2018

(GHD 7/08/2018)

<u>Point</u>	<u>RL</u>	<u>Difference Previous</u>	<u>Difference From BaseLine</u>
E1	103.476	0.000	0.004
E2	103.476	0.000	0.001
IB1	103.253	0.000	0.002
IB2	103.246	0.000	0.000
IB3	103.271	0.000	0.001
IB4	103.318	0.000	0.001
IB5	103.263	-0.001	0.000
IB6	103.301	0.000	0.000
IB7	103.236	-0.001	-0.003
D1	103.637	0.001	-0.006
D2	103.701	0.001	-0.004
E3	102.942	0.000	0.002
E4	103.025	0.000	-0.001
D3	103.591	0.000	-0.003
D4	102.753	-0.001	
D5	102.868	0.000	
D6	103.237	0.000	

Clonbern Rd Carpark Monitoring - Level 2 Crack Measurements (mm)

(Refer Appendix C)

<u>Point</u>	<u>Opus (7/6/2017)</u>	<u>GHD (20/12/2017) - Elometer 143</u>
1A	2.25	2.5
1B	3	2.0
2A	1.75	1.75
2B	0.7	0.8
3A	2	2.0
3B	0.8	0.6
4A	1.5	1.25
4B	2.5	1.75
5A	1.25	1.25
6A	2.5	2.5
6B	1	1.5
7A	2	1.75

Date of Survey: 20/12/2017 - GHD BM - Monitoring Pins

<u>Point</u>	<u>Digital Caliper(BM mm)</u>
1A	77.41
1B	48.15
2A	51.53
2B	48.92
3A	56.55
3B	52.03
4A	39.19
4B	57.41
5A	52.9
6A	60.98
6B	50.51
7A	53.06

Date of Survey: 31/012018 - GHD - Monitoring Pins

<u>Point</u>	<u>Digital Caliper(mm)</u>	<u>Difference Previous</u>
1A	76.51	0.90
1B	47.60	0.55
2A	51.27	0.26
2B	48.94	-0.02
3A	56.78	-0.23
3B	51.53	0.50
4A	39.82	-0.63
4B	57.49	-0.08
5A	53.08	-0.18
6A	60.50	0.48
6B	50.61	-0.10
7A	52.97	0.09

Date of Survey: 28/02/2018 - GHD - Monitoring Pins

(GHD 31/1/2018)

<u>Point</u>	<u>Digital Caliper(BM mm)</u>	<u>Difference Previous</u>	<u>Difference BM 20/12/2017</u>
1A	76.66	0.15	-0.75
1B	47.55	-0.05	-0.6
2A	50.34	-0.93	-1.19
2B	48.61	-0.33	-0.31
3A	55.85	-0.93	-0.7
3B	50.97	-0.56	-1.06
4A	39.58	-0.24	0.39
4B	57.3	-0.19	-0.11
5A	53.1	0.02	0.2
6A	60.74	0.24	-0.24
6B	50.65	0.04	0.14
7A	53.78	0.81	0.72

Date of Survey: 5/04/2018 - GHD - Monitoring Pins

(GHD 28/02/2018)

<u>Point</u>	<u>Digital Caliper(BM mm)</u>	<u>Difference Previous</u>	<u>Difference BM 20/12/2017</u>
1A	76.9	0.24	-0.51
1B	47.83	0.28	-0.32
2A	50.96	0.62	-0.57
2B	48.36	-0.25	-0.56
3A	56.2	0.35	-0.35
3B	50.77	-0.20	-1.26
4A	39.37	-0.21	0.18
4B	57.6	0.30	0.19
5A	53.43	0.33	0.53
6A	61.11	0.37	0.13
6B	50.89	0.24	0.38
7A	52.88	-0.90	-0.18

Date of Survey: 26/04/2018 - GHD - Monitoring Pins

(GHD 5/04/2018)

<u>Point</u>	<u>Digital Caliper(BM mm)</u>	<u>Difference Previous</u>	<u>Difference BM 20/12/2017</u>
1A	76.2	-0.70	-1.21
1B	47.61	-0.22	-0.54
2A	49.84	-1.12	-1.69
2B	48.47	0.11	-0.45
3A	56.03	-0.17	-0.52
3B	51.38	0.61	-0.65
4A	39.22	-0.15	0.03
4B	57.06	-0.54	-0.35
5A	53.2	-0.23	0.3
6A	60.69	-0.42	-0.29
6B	50.81	-0.08	0.3
7A	53.07	0.19	0.01

Date of Survey: 6/06/2018 - GHD - Monitoring Pins

(GHD 26/04/2018)

<u>Point</u>	<u>Digital Caliper(BM mm)</u>	<u>Difference Previous</u>	<u>Difference BM 20/12/2017</u>
1A	76.36	0.16	-1.05
1B	47.42	-0.19	-0.73
2A	50.62	0.78	-0.91
2B	48.51	0.04	-0.41
3A	56.2	0.17	-0.35
3B	51.13	-0.25	-0.9
4A	39.39	0.17	0.2
4B	56.93	-0.13	-0.48
5A	52.86	-0.34	-0.04
6A	60.7	0.01	-0.28
6B	50.49	-0.32	-0.02
7A	53.08	0.01	0.02

Date of Survey: 13/07/2018 - GHD - Monitoring Pins

(GHD 6/06/2018)

<u>Point</u>	<u>Digital Caliper(BM mm)</u>	<u>Difference Previous</u>	<u>Difference BM 20/12/2017</u>
1A	76.89	0.53	-0.52
1B	47.72	0.30	-0.43
2A	50.65	0.03	-0.88
2B	48.56	0.05	-0.36
3A	56.63	0.43	0.08
3B	51.15	0.02	-0.88
4A	39.46	0.07	0.27
4B	57.52	0.59	0.11
5A	53.33	0.47	0.43
6A	61.39	0.69	0.41
6B	51.00	0.51	0.49
7A	53.20	0.12	0.14

Date of Survey: 7/08/2018 - GHD - Monitoring Pins

(GHD 13/07/2018)

<u>Point</u>	<u>Digital Caliper(BM mm)</u>	<u>Difference Previous</u>	<u>Difference BM 20/12/2017</u>
1A	76.72	-0.17	-0.69
1B	47.49	-0.23	-0.66
2A	50.49	-0.16	-1.04
2B	48.35	-0.21	-0.57
3A	56.18	-0.45	-0.37
3B	50.6	-0.55	-1.43
4A	38.99	-0.47	-0.20
4B	56.93	-0.59	-0.48
5A	53.25	-0.08	0.35
6A	60.72	-0.67	-0.26
6B	50.54	-0.46	0.03
7A	52.75	-0.45	-0.31

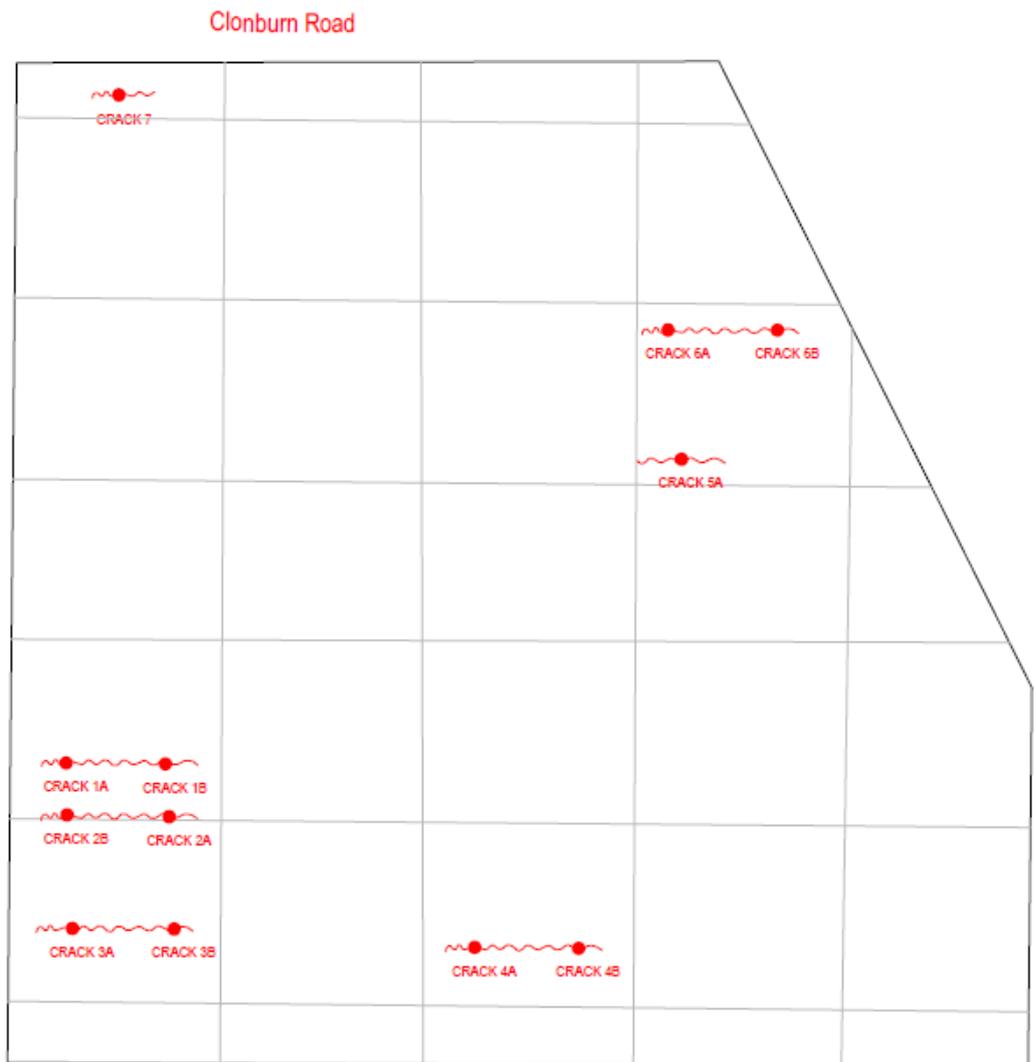
Date of Survey: 11/09/2018 - GHD - Monitoring Pins

(GHD 7/08/2018)

<u>Point</u>	<u>Digital Caliper(BM mm)</u>	<u>Difference Previous</u>	<u>Difference BM 20/12/2017</u>
1A	76.36	-0.36	-1.05
1B	47.92	0.43	-0.23
2A	51.07	0.58	-0.46
2B	48.51	0.16	-0.41
3A	56.61	0.43	0.06
3B	50.67	0.07	-1.36
4A	38.91	-0.08	-0.28
4B	57.05	0.12	-0.36
5A	53.28	0.03	0.38
6A	60.7	-0.02	-0.28
6B	50.66	0.12	0.15
7A	53.14	0.39	0.08

Appendix C – Crack Monitoring Layout Plan and Photos

Crack Monitoring Layout Plan



Crack Monitoring and Deflection Photos

Structure Type: Reinforced Concrete and Hollow Core structure

Location: Clonbern Road

Date: 06/06/18

Area: Remuera



1. Level 2, 1A location.



2. Level 2, 1B location.



3. Level 2, 2A location.



4. Level 2, 2B location.



5. Level 2, 3A location.



6. Level 2, 3B location.



7. Level 2, 4A location.



8. Level 2, 4B location.



9. Level 2, 5A location.

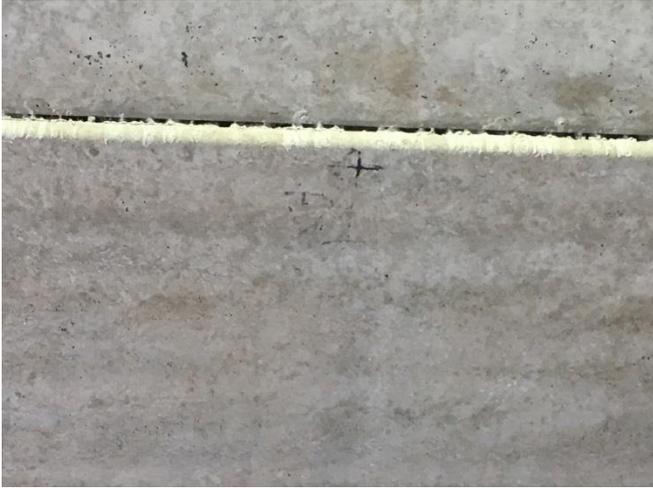


10. Level 2, 6A location.



11. Level 2, 6B location.

12. Level 2, 7A location.



13. D1 Monitoring Point



14. D2 Monitoring Point



15. D3 Monitoring Point



16. D3 – Water staining through joint with vegetation growth

Appendix D – Site Visit Record

Site Inspection Record



Name:	Paul Murphy
Contract:	320-17-670-AC – Professional Services AT Metro Structures and Facilities
GHD Job Number:	5137681
Site:	Clonbern Rd carpark, Remuera
Work Undertaken:	Survey Monitoring – deflection and cracks
Date:	11/09/2018
Time:	9.00 am
Weather:	Fine

Personnel Protective Equipment (PPE)				
Item	N/A	Yes	No	Notes
Hi Vis Jacket		Y		
Footwear		Y		
Hat		Y		
Sun Block		Y		
Gloves			N	
Gas Detector			N	
Hard Hat			N	
Other Equipment				
Item	N/A	Yes	No	Notes
Cell Phone		Y		
First Aid Kit		Y		
Water		Y		
Site Specific Safety Plan		Y		

Comments/Improvements

Signature	Name	Status
	PAUL MURPHY	Surveyor

GHD

Level 3, GHD Centre
27 Napier Street

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	P Murphy	J Tetteroo/ F Khalilnejad		V Chandra		25/09/18

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